129 The Oral Cavity and Associated Structures

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Definition

A tooth (Figure 129.1) consists of a *crown* and a *root.* The crown is covered with enamel, and the root is covered with cementum. The bulk of the tooth is composed of *dentin.* A cross section of a tooth reveals a pulp chamber in the crown and a pulp canal in the root. These communicate with each other. Together they form the pulp cavity that houses the *pulp tissue.* This pulp tissue furnishes the blood and nerve supply of the tooth.

A periodontal ligament made up of connective tissue surrounds the root of the tooth and connects it with the bone. Each tooth sets in a bony crypt, or socket. That portion of the maxilla and mandible that forms the sockets of the teeth is termed the *alveolar process* and is made up of cancellous bone enclosed within cortical plates. The alveolar bone is covered by specialized oral mucosa known as *gingiva,* or, more commonly, gums. The remainder of the oral cavity is covered with an oral mucous membrane.

Tooth germ formation of the primary or baby teeth begins 7 to 10 weeks *in utero.* This is followed by enamel and dentin apposition from 4 to 6 weeks *in utero.* This process is repeated by the various primary and permanent teeth from 7 weeks *in utero* to 4 years of age.

Human dentition is best represented by three stages, which overlap. These stages are the primary, mixed, and permanent dentition. The *primary dentition,* or "baby teeth," begin to appear at 6 to 9 months of age. The full complement of 20 teeth can be seen by age 3 years ± 6 months. *Mixed dentition* can be seen from ages 6 years ± 9 months to age 12 years ± 6 months. There is a wide variance in age of the mixed dentition stage. By age 12 or 13 the *permanent dentition* is predominant. Twenty-eight teeth constitute the normal permanent dentition until age 18 to 21, at which time 4 third molars (or wisdom teeth) may appear. Frequently they are impacted or enclosed in bone. They also may be tilted and cannot erupt.

Occlusion is defined as the interdigitation of teeth as the mandible is closed against the maxilla. The teeth should be in close apposition in the arch, each one lending support to the other (Figure 129.2).

The posterior teeth are slightly *buccal,* or to the outside

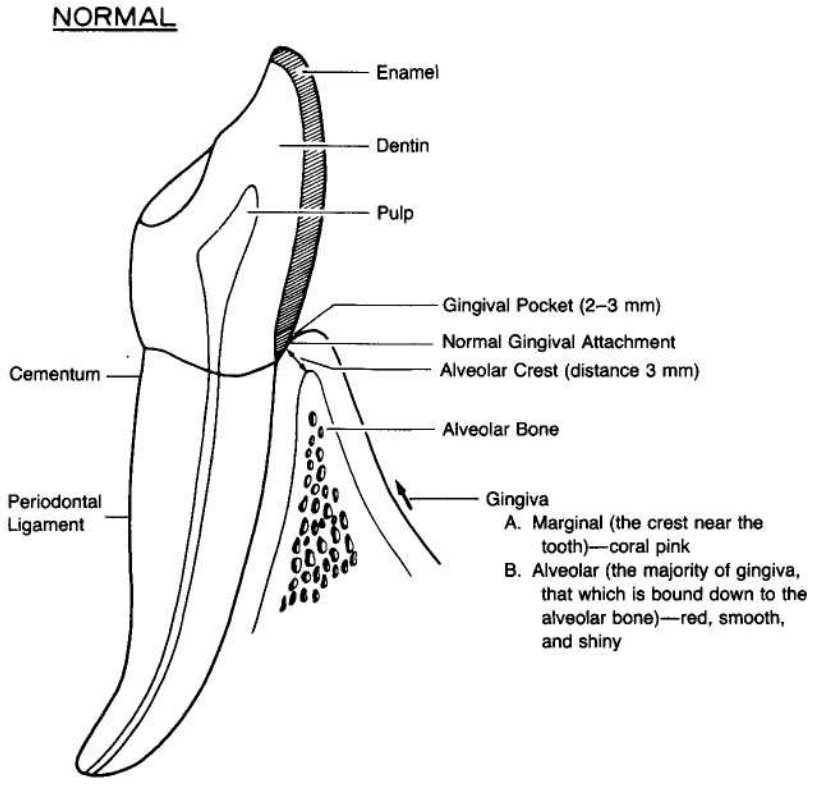

Figure 129.1
Normal tooth and supporting structures.

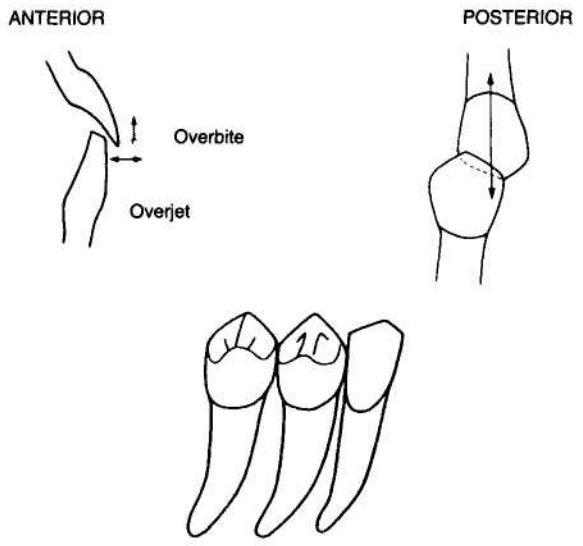

Figure 129.2
(Top) Normal occlusion, anterior and posterior views. (Bottom) The roots are slightly inclined toward the back of the mouth, thereby giving a slight forward thrust to each tooth to help maintain its place in the arch.

of the lower teeth. The long axes of the roots are tilted slightly to accommodate this arrangement. The front, or anterior, teeth are in a similar alignment but more pronounced, with the upper teeth extending further out over the lower teeth and further down on the outer surface. The amount of horizontal clearance is referred to as *overjet* and the amount of vertical overlap as *overbite*. This occlusal relationship represents the dentition closed; ordinarily, however, we let our jaws hang loose or at rest. At this time, they are about 3 mm apart. This is referred to as the *physiological rest position*.

The normal gingiva is coral pink and firm. The gingiva adhering to the tooth is called the *marginal gingiva*. It is continuous with the *attached gingiva* that covers the alveolar process. The attached gingiva is red, smooth, and shiny.

The skin (dry zone) of the lip has all the components of facial skin: sweat and sebaceous glands and hair. The *vermilion border*, or inner surface of the lip, has neither hair nor sweat glands. It is characterized by a thin, hornified epithelium that is abundant in cleidin, a transparent protein. For this reason, the underlying capillary network may be readily visualized and the lips appear either pink or red depending on the state of the capillaries. Continuous with the vermilion border of the lip is the oral mucosa.

Given the multiple structures that make up the oral cavity, abnormalities can abound. Many are overt and many are subtle. Common abnormalities of the teeth and associated structures include caries, pyorrhea, plaque, periodontal pockets, and periapical abscesses (Figure 129.3).

Technique

Seat the patient in an upright position, preferably with the head supported in the back, much as in a dental chair. Bedridden patients present no special problem. Raise the

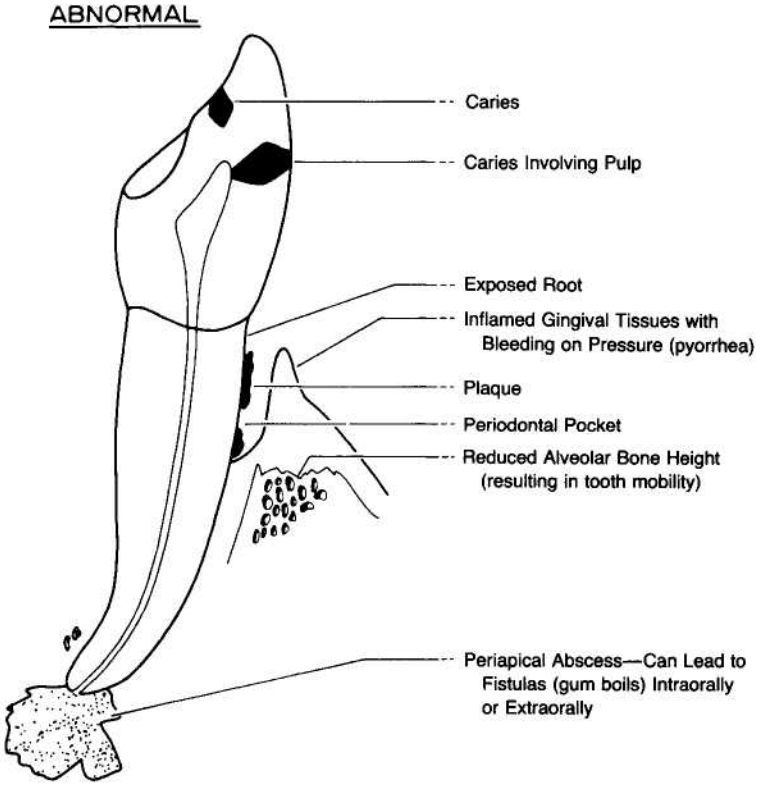

Figure 129.3
Potential abnormalities.

bed to a 30 to 45 degree angle; the pillow can act as a head support.

The examiner needs a good flashlight or clinical examination light, tongue blades, examination gloves, and 2 × 2 gauze sponges.

An established routine for the examination of the oral cavity is essential. A suggested routine includes the following examination:

1. Ability to open and close jaws maximally and without deviation
2. Inner surfaces of the cheek
3. Mucosa of the cheek
4. Maxillary and mandibular mucobuccal folds
5. Palate
6. Tongue
7. Sublingual space
8. Gingivae
9. Teeth and their supporting structures
10. Occlusion
11. Muscles of mastication
12. Temporomandibular joint

Have the patient open and close the mouth maximally. Note any apparent restriction on the patient's ability to open freely to a distance of 4.0 to 4.5 cm, and any deviation to right or left.

Gently grasp the mandibular lip between your thumb and forefinger and roll it downward. Note the difference in the appearance of the normal tissue between the dry border and the wet mucous membrane, referred to as the *vermilion border*.

Inspect for the presence, size, and position of any unusual growth or any change in the normal appearance, such as white spots or leukoplakia.

If the patient is wearing dentures or partial dentures, have the patient remove the prosthesis and place it on a clean paper towel. To observe the right buccal mucosa, have the patient open about halfway. Holding the tongue blade in your left hand, gently place it just inside the patient's right buccal mucosa, using your right hand to direct the flashlight or clinical light. Move the tongue blade upward and downward several centimeters while pressing outward, thereby revealing the entire mucosa front to back and from the maxillary to the mandibular vestibules.

Direct your attention to the mucosa across from the maxillary first molar. Here lies the orifice to the parotid gland. Under normal conditions, saliva may be readily expressed by gently pressing back to front bimanually with one finger on the cheek and the other opposing it intraorally. The orifice itself appears to be on a small raised mass of tissue. With the same technique, inspect the mucobuccal folds or vestibules. Have the patient tilt the head backward as far as possible and open the mouth as wide as possible. Using your light, scan the palate from back to front. As your light passes from the soft palate on to the hard palate, the tissue will become rougher, culminating in rugae, which are raised transverse projections of dense connective tissue just behind the maxillary incisors. Many investigators believe the rugae aid in speech; thus some attempt is made to reproduce them in artificial dentures.

Frequently, near the midline of the hard palate, you will note a bony outcropping (torus palatinus) or exostosis that resembles a small smooth pebble covered by skin. It is totally benign, fairly common, and of no concern unless complete upper dentures need to be made.

The left buccal mucosa and mucobuccal folds may be viewed by using the reverse procedures from the right.

To inspect the tongue properly, put the patient at ease and tell him or her exactly what to expect. Stand to the front right of the patient with a 2 × 2 gauze sponge in your right hand. The patient should be facing forward. Ask the patient to extend the tongue from the mouth as far as possible without forcing. Gently grasp it at the tip with a 2 × 2 gauze sponge and pull it forward and to the patient's left. Visualize the right lateral border with the aid of the clinical light. Then use your gloved left index finger gently but firmly to palpate the patient's right lateral tongue border, looking for masses, irregularities, or sore points. This is a common site for squamous cell carcinoma. Early diagnosis is crucial because over 50% of these lesions have metastasized by the time of diagnosis. (Many investigators feel the high incidence of carcinoma in this area is attributed to trauma as the tongue brushes past the mandibular molars during deglutition and speech.) Reverse hand roles without changing either your or the patient's position; inspect the left surface of the tongue.

To inspect the sublingual space, have the patient place the tongue in the roof of the mouth and open wide. Because of its relative protection from food, the sublingual space does not have highly keratinized epithelium. It is also not a likely site for intraoral carcinoma, but due to its abundant lymphatic drainage, cancer in this space is likely to have metastasized.

Focus your attention on the middle fold of the ventral surface of the tongue, the lingual frenum. Ordinarily, this frenum attaches about one-third of the way back from the tip of the tongue. Occasionally in children this attachment will be almost to the tip of the tongue, with the result that the child is "tongue-tied." The inability of the child to place the tongue in the roof of the mouth just posterior to the maxillary incisors to form the "T" sound results in early speech defects.

At the base of the lingual frenum is the salivary caruncle, which includes the openings to the submaxillary ducts that drain the submaxillary glands and the sublingual ducts that drain the sublingual glands. Near the posterior limits of the sublingual space and near the lingual border of the mandible may be seen salivary eminences that mark the superior surfaces of the sublingual glands, the remaining portion of the gland being nestled in the lingual fossa, which is a shallow depression in the mandible itself. If oral carcinoma is detected in the sublingual space, its most common site will be at the junction of the tongue with the floor of the mouth.

The normal tooth appears white and without obvious signs of decay. The gums (gingiva) are pink to red, without signs of recession from the tooth or bleeding. Obvious dental decay can usually be detected and inspected. Often the patient cannot identify a specific tooth on one side. In fact, frequently a patient cannot isolate an upper arch versus a lower arch as the source of pain. In the absence of radiographs, simple percussion can be a most valuable guide. Percuss the suspected tooth and two to three adjacent teeth for comparison. Almost always, the offender can be identified easily by the patient.

Have the patient open wide. With the tongue blade in your left hand, place it in the patient's right commissure and gently draw the right cheek outward; begin with gentle downward pressure to allow you to inspect the mandibular

gingivae and next use gentle upward pressure to reveal the maxillary gingivae. Are the teeth smooth and shiny near the attachment, or is there obvious plaque deposition near the gingiva? Note the color of the gums. A pink to red color denotes healthy tissue. Are the roots of the teeth exposed, suggesting advanced periodontal disease? Use the pad of your right index finger to exert pressure along the gingival crest from back to front. Note bleeding on pressure and in some cases frank pus extruding from between the gums and the teeth. Without varying your position, glance at the maxillary and mandibular teeth on the right. Note overt caries and missing teeth. Use finger pressure to test for mobility of teeth.

Switch the tongue blade to your right hand, and examine the patient's gingiva and teeth on the left in the same manner.

Last, have the patient close the mouth in the normal bite and "bare the teeth." Now using your tongue blade to retract either cheek, visualize the patient's occlusion. Obvious occlusal deformities should be noted. Many occlusal deformities can be corrected by oral surgery and orthodontic treatment.

Any discussion of the teeth and their occlusion must include a reference to the muscles of mastication and the temporomandibular joint. These three systems may be viewed separately for pure anatomic considerations, but represent a finely balanced and dynamic relationship in the patient. Any clinician who has observed a case of acute gonococcal arthritis of the temporomandibular joint, a fractured mandible, or a painful abcess of a molar tooth can attest to this fact.

An integral part of occlusion and the ability to masticate properly is bilateral symmetry of the muscles of mastication. The main group of muscles consists of the masseters, temporalis, and internal and external pterygoids. Their attachment to the mandible and the maxilla enable the patient to open and close the mouth at will.

Examine the muscles of mastication next. Face the patient directly. Note any bilateral asymmetry, beginning at the midcheek area and extending to the angle of the mandible posteriorly and up to the temporal area superiorly. If asymmetry exists, the masseters and external pterygoids may be palpated bimanually.

Have the patient hold the jaw slack. Place your right gloved forefinger intraorally, opposing your left finger. Palpate the muscles in this fashion, looking for lumps or masses.

The third component of occlusion is the temporomandibular joint. With the teeth in occlusion and the muscles of mastication in contraction, the head of the condyle is in its most posterior and superior position in the glenoid fossa, which is shaped like a flattened S.

The temporomandibular joint is a complicated joint of the ginglymoarthrodial type. It has three main movements along the glenoid fossa: downward, forward, and rotational, as the mandible opens and moves from side to side.

To examine the temporomandibular joint, face the patient once again. Turn your little fingers toward you and gently insert them into the patient's external auditory meatus. Have the patient open and close several times. You should be able to feel the heads of the condyles as they move forward and down to begin the opening movement in the glenoid fossae.

Position yourself in front of the patient's ear. Place your stethoscope 7 to 10 mm in front of the tragus of the ear and on a line to the alae of the nose. Listen carefully for signs of grating or crepitus as the patient opens and closes. The condyle head may also be palpated externally at this point.

Basic Science

The peculiarities of the oral cavity are unique. No other body cavity shares such a close relationship to the external environment, represents as many varied and functional anatomical entities, or contains bacterial flora in the amount or variety encountered in the normal human mouth.

The mechanical irritation of smoking, eating, and drinking alters the "normal" appearance of the oral cavity from one patient to another, and in many instances in the same patient from week to week. The warm, moist contents of the mouth harbor enormous bacterial populations that immediately superimpose themselves on lesions, whether mechanical or pathological, and frequently distort the diagnostic picture by giving the lesions the appearance of being bacterial in nature. Lesions of the mouth cannot form "crusts" due to the dissolving effect of saliva; wet-line lip lesions have different physical appearances than do dry-line lip lesions. While many abnormalities of the oral cavity are purely dental in origin and scope, many are not.

Sir William Osler was the first to refer to the mouth as the "mirror" of the body. Early signs of many of the common degenerative diseases, nutritional deficiencies, and disease of metabolism are seen intraorally before they are physically apparent elsewhere. The enamel and dentin are fixed records of the past history of the individual. The alveolar bone, the gingiva, and the tongue are indicators of the present systemic state of the individual.

Our diet plus the mineral constituents of our saliva lead to the formation of dental plaque, which consists, for the most part, of bacteria with a scattering of leukocytes, macrophages, and epithelial cells contained within an amorphous ground substance matrix. The plaque is soft at first and may be brushed away with a soft toothbrush. About 2 to 14 days after the formation of soft plaque, the precipitation of calcium salts begin to harden the plaque until it becomes hard dental calculus.

Current dental research indicates that plaque, sugar, and streptococci must all three be present and in sufficient quantities before dental caries can be initiated.

Except when masticating and swallowing, the jaws are usually in a "rest" position approximately 3 mm apart. On closing, the condyle goes to its most posterior position in the glenoid fossa, the closing muscles contact, and the teeth contact. This in itself is a complicated maneuver involving numerous neuromuscular reflexes, teeth that occlude, and conscious effort. However, this only begins the chewing motion. We chew only on one side at a time. Dentists refer to this as the "working" side involving the actual grinding. At the same time, the opposite side of the dental arch is involved in "balancing" as the lower buccal cusps glide up to and balance against the lingual cusps of the upper molars. As this occurs, different opening and closing muscles are brought into play, and each condyle head goes through different motions.

Taken quite literally, there are many components interacting to produce the chewing motions that we take for granted, and the disruption of any of these components can lead to problems. For instance, a new filling that is only 0.5

mm too high can interfere with chewing to such an extent as to make eating impossible.

Edentulous patients are a different case entirely. Dentures must closely mimic the natural dentition in terms of jaw distances on closing. If they do not, then temporomandibular joint dysfunction can result.

Clinical Significance

Oral manifestations of systemic diseases, malocclusion, and the more local aspects of dental problems (e.g., caries and periodontitis) should be viewed in the proper context. A normal healthy dentition functioning in a healthy oral cavity is critical to the patient's nutritional well-being. Anything that interferes with mastication at the beginning of the digestive process only makes function of the patient's other systems more difficult. Early recognition of this fact can often be the critical factor in rectifying future problems. This often falls to the physician because many patients never visit a dentist or seek dental care until they have a specific dental problem.

Oral carcinoma as the primary site represents about 3% of the total occurrence of carcinoma. Due to the abundant drainage of the oral cavity, early metastasis via the lymphatic and venous systems is common. The lungs and breasts are the most common areas of secondary involvement. Approximately 9000 deaths a year are now accorded to oral cancer. The 5-year cure rate is less than 33% for all cases, one of the lowest for any form of cancer. However, the number of victims surviving 5 years is doubled if treatment is initiated when the lesion is less than 2 cm in diameter.

Inability to open and close the mouth maximally can indicate an acute process or a chronic one. Examples of an acute process include a focal abscess involving any of the muscles of mastication or a fractured zygoma, which hinders the movement of the coronoid process of the mandible. Chronic inability to open the mouth freely can be due to ankylosis of the temporomandibular joint or result from a formerly broken and unmanaged condyle head or can be caused by long-standing arthritis.

Deviation of the mandible to either right or left can reveal the same type of acute or chronic processes. Local invasion of a basal or squamous cell carcinoma or tuberculosis involving the temporomandibular joint can cause the muscles of mastication to present the same clinical picture.

The lip is the most common site of oral carcinoma, with squamous cell restricted to the lower lip in about 99% of cases and occurring more often in men than in women (ratio 15:1). It is most commonly a result of overexposure to sunlight (actinic radiation). Fortunately, it tends not to metastasize and may be treated by a wide local excision or irradiation. Basal cell carcinoma commonly occurs on or above the maxillary lip.

The buccal mucosa is a common site for leukoplakia, defined clinically as a white patch that will not rub off (moniliasis, for instance, will rub off). It is a precancerous lesion that should be biopsied or removed. Cancer of the buccal mucosa appears most frequently in the middle third of the cheek. The vestibules are common sites for leukoplakia caused by snuff dipping.

Cancer of either the hard or soft palate is usually squamous cell, but it can be glandular. It may begin as a shallow punched-out ulcer with rolled indurated margins or it may be papillary with a wide base. Failure to detect the lesion early can lead to oral–antral or oral–nasal fistulas.

The tongue is the second most common site of oral carcinoma with the more posterior lesions generally being the most malignant ones. Unlike most other oral cancers, pain can be an early symptom. Carcinoma of the tongue can present as leukoplakia, an ulceration, or as the papillary type, and may extend into the floor of the mouth. The junction of the lateral base of the tongue and the anterior tonsillar pillar is a common site for a fissure-appearing lesion that is easily missed on examination. Over 50% of all tongue cancers have metastasized by the time of detection.

Cancer in the sublingual space is often associated with leukoplakia, although this is not a common site for leukoplakia. As a general rule, the more posterior the lesion, the more malignant it is. Early metastases to the cervical lymph nodes are common.

If plaque accumulates near the gingival attachment, especially in the 3 mm normal gingival "pocket," it becomes a source of chronic irritation. This eventually leads to chronic inflammation of the gum tissues with resultant downward migration of the gum attachment. This leads to a progressive loss of bone (since physiologically the height of the supporting alveolar crest bone is always 2 to 3 mm below the gingival attachment), deeper gum pockets, accumulation of more bacteria including anaerobic strains in deeper pockets, mobile teeth, and bleeding gums. The common term for these signs and symptoms is *pyorrhea.* It may occur in only one area of the mouth or throughout the dentition; it may occur early in childhood or after approximately 40 years of slow buildup.

Periodontal pain due to chronic or acute periodontal disease is generally characterized as an ache or pressure-related ache, in contrast to the "heart-throbbing" quality of a dental pulp pain or classic toothache. If allowed to encroach on the dental pulp, decay leads to pulpal necrosis with resultant death to the neurovascular component of the tooth. Necrosis of the dental pulp usually begins at the apex of the root where the foramen is small and therefore the blood supply most vulnerable. At this time, the pain is usually of the "heart-throbbing" nature characteristic of a vascular component. If allowed to progress, the necrosis results in an abscess at the apex of the root.

Accumulation of purulent exudate at the root of the tooth continues until relieved by root canal therapy or tooth extraction or until erosion of nearby bone opens a fistula, usually on the outside of the dental arch because buccal bone is thinner than lingual bone.

The first signs of an abscess with resultant cellulitis can be a large swelling or fistula on the face near the apex of any of the teeth. This is not uncommon because frequently the apex of certain teeth are below the attachment (or above on the maxilla) of the buccinator, mentalis, mylohyoid, or other muscles, and the easiest avenue for the fistula is through subcutaneous tissue directly on to the face rather than through muscle attachments back into the oral cavity.

Occlusion is the key to mastication. Severe occlusal deformities can frequently be corrected by a combination of orthodontics and orthognathic surgery.

Because the muscles of mastication, occlusion, and the temporomandibular joint are so closely related functionally, pathology in this area is often difficult to pinpoint. A frequent complaint involves the so-called temporomandibular joint syndrome. The patient reports pain on opening or closing the mouth and, more specifically, on chewing, occurring in the general area of the external auditory meatus. Current investigators attribute this to a disruption of occlusion that causes the muscles of mastication to spasm, which

exacerbates the occlusal disharmonies. This cyclic phenomenon is difficult to break and requires a combination of drugs, physical therapy, and occlusal adjustments in most cases. Certain drugs such as aspirin, the monoamine-oxidase inhibitors, compazine, stelazine, or thorazine are also capable of causing pain that closely resembles this phenomenon.

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